THE DISINFECTION OF THE ALIMENTARY CANAL.

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When considering the alimentary canal from any point of view, pathological or therapeutical, we should begin by paying particular attention to the mouth. It is mainly endangered in the very young, and most of all in the newly born.

There are several reasons (mostly discussed by Rudolph Fischl, in *Volkman's Clinical Lectures*, No. 220) why microbes of so little virulence as not to prove dangerous to the adult should be fatal to the newly born. It is true the phagocytic reaction is but trifling in the newly born, his blood is less alkaline, there is but little tendency to fever, and his lymph nodes do not respond much to inflammatory irritation. However, some such protections of the adult as expectoration or perspiration are absent; that is why the intestines and the kidneys are the only eliminators. The hard part of the epidermis of the newly born is not developed, according to Hulot; the epithelia are still of an embryonal character, and there is a copious normal desquamation of all the integuments, both cutaneous and mucous. Thus, between the injured or partly lost epithelia ample admission is secured to the nomadic tribes of untold microbes. That is particularly so in the prematurely born, whose tissues are still more of the embryonal type than those of the mature fœtus. Thus it may happen that some of the pyogenous cocci which are known to occur in normal vaginal mucus suffice to infect a newly born. Not the least additional factor in causing danger is the symbiosis of schizomycetæ with putrefaction microbes, whose co-operation becomes particularly manifest in the infections which originate either in the umbilicus or in the mouth.

The newly born and the infant are left to the care of others; they cannot protect themselves. As they cannot expectorate, so they cannot gargle or wash. Their food when given hot injures the epithelia; their mouth is washed and rubbed sore with a coarse cloth,

dipped in unsterilized water by unclean or septic fingers. Their very screaming, while pulling at the mucous membrane of the posterior part of the alveolar process, through traction of the pterygoid muscle, induces local anæmia and rupture and necrosis of the mucous tissue, and causes the "aphthæ of Bednar," which, according to Fränkel, frequently harbor staphylococcus citreus. Malformations of the mouth, such as cleft palate, add to the recesses in which bacteria may find a nest. The slightest abrasions occasion the development of thrush, the oidium of which is capable of entering the œsophagus and the stomach, also the brain, the spleen, and the kidneys. Food, air, and fingers carry into the mouth leptothrices, streptococci and staphylococci pyogenes, pneumococci, bacteria coli, and Klebs-Loeffler bacilli, which are absolutely harmless, with few exceptions, *as long as the surface of the oral cavity is normal*, but enter the lymph-circulation and the blood-circulation when a superficial lesion favors the admission of microbes. As long as no lesion takes place no amount of microbes establishes the diagnosis of an infectious disease. That is why our boards of health are apt to make mistakes and to shoot beyond the aim. For the responsibility they have in connection with the sanitary interests of the public is quite liable to carry them too far in depriving of their personal liberty those who, like many perhaps of us here, harbor any number of bacteria in their mouths without being sick. With the exception of what occurs in the tonsils on which the normal epithelia may be interrupted in their close juxtaposition, they do not enter the circulation unless there be hyperæmia, catarrh, or ulceration. Such stomatitis and pharyngitis were always considered a secondary symptom of an infectious disease; it is more probable, however, that they, particularly the adenoid organs, tonsils, etc., are the first to be infected and furnish the inlets of infection. That is mainly so, however, in later life, not in the earliest infancy; here the palatine tonsils are mostly still small and smooth, and are frequently and easily washed clean during swallowing. Later on, perhaps, influenza and measles, very likely scarlatina, rheumatism, and erysipelas may take their origin in the nasopharyngeal cavity. Cerebro-spinal and other meningitides are known to have been occasioned in this way. Puerperal fever in the newly born, osteomyelitis, and suppuration around a simple fracture have been observed under the same circumstances. In advancing years frequent repetitions of pharyngitis, deepening of the lacunæ, and fistulæ dating from previous abscesses give ample opportunities

to invading microbes. During infancy, also during the diseases of advanced age, which are complicated with unconsciousness, such as apoplexy, typhoid fever, or pneumonia, remnants of food remain in the recesses of the mouth, disintegrate and lead to irritation, inflammation, and infection.

The œsophagus is not likely to be affected in a similar way. Still, twenty-five years ago I published the case of a small boy who had a stricture of the œsophagus from drinking lye. The autopsy revealed, besides fibrinous bronchitis, diphtheria of the cicatrix.

To prevent microbic invasions the mouth should be kept clean. It should be washed after every meal and at bedtime with water or with a mild solution of borax or boric acid. Those wearing artificial teeth should be particularly careful. A few drops of tincture of myrrh in a glass of water, or a solution of salicylic acid in 500 or 1000 parts of water, or a mild solution of permanganate of potassium (1 : 3000-4000) is quite satisfactory. The regular use of a soft tooth-brush or of a coarse cloth is fortunately a universal habit among clean people. The mouth of patients who are unconscious should be moistened at short intervals; the dry typhoid tongue touched once or twice a day with a 1 per cent. solution of nitrate of silver. The composition of tooth-powders should be known; those containing strong alkalies avoided.

The use of chlorate of potassium is advisable in any case of incipient stomatitis. A solution of 1 part in 50 of water is mostly sufficient. But the internal use is often preferable in established and progressive cases. To have a speedy effect, it should be taken at short intervals—every hour or every half hour; the dose should be held in the mouth a minute and slowly swallowed. The daily dose should not exceed four or five grammes for an adult; one gramme or less for an infant. If the latter is not to take it, a few drops of a 2 or 3 per cent. solution may be brushed on the mucous membrane. It should never be forgotten, however, that the persistent internal use of chlorate of potassium may prove dangerous. Since the first cases of poisoning I published in Gerhardt's *Handbuch der Kinderkrankheiten* in 1876, and those reported by me to this Society in 1879, a great number of deaths from the same cause are known to have occurred.

Tiny infants unable or unwilling to clear their mouths of food remnants should be given a teaspoonful or more of water after a meal. Washing of the mouth, when considered necessary, should be

done with great care, and not in the newly born only, for the reasons detailed before. No direct local application should be made to the throat; the force required for that purpose and the struggle on the part of the little ones make them at least very unadvisable. The best way to get at the throat is through the nose and nasopharynx, which are so often the seat of chronic catarrh, ulcerations, and adenoids in the very young. The regular irrigations with warm salt water made by means of a nasal cup (better than spoons, droppers, or syringes) are very beneficial. They clear the narrow cavities of mucus which cannot be otherwise removed and of foreign material which finds a ready access. Of that nature are tubercle and diphtheria bacilli, and saprophytes. One of our specialists objected some time ago to these preventive irrigations, for the reason of their alleged superfluousness. He said that nobody irrigated the stomach regularly and as a matter of prevention; and what was objectionable in one cavity was so in others. He merely forgot that the stomach is not accessible to the atmosphere and the dust of the street; that there is no high road into the stomach for diphtheria, tubercle, and typhoid bacilli; that, on the contrary, they are destroyed by the normal secretion of the stomach.

The several diseases of the mouth and throat have their own indications. They should not concern us here.

The hydrochloric acid of the stomach has a germicidal effect. Strauss and Wurtz observed it to kill anthrax in half an hour, typhoid and cholera bacilli in from two to three hours. But they also found that the same amount of hydrochloric acid would act better in a test-tube than in the stomach in which it is mixed with chyme or combined with albumin. Thus it happens that bacilli of typhoid *may* pass the stomach uninjured. That occurs mainly when the stomach secretes but little hydrochloric acid—for instance, in hydræmia, in catarrh, or in other cases of achylia gastrica. Such conditions furnish at once the indication of administering hydrochloric acid, both for its digestive and its germicidal action.

Fermentations occurring in the milk on which infants and children are fed have been studied very extensively. They occur so frequently as to explain the multiple infections of the infant intestine. Lactic fermentation exhibits Pasteur's bacillus lactis, also staphylo- and pneumococcus; the fermentation of casein, Duclaux's tyrotrix, leptothrix buccalis, bacillus subtilis and mesentericus, and

others. Butyric fermentation is secondary to lactic fermentation, and is due to the presence of bacillus butyricus, which is found in milk contemporaneously with bacillus lactis, but remains latent until lactic fermentation is completed. It lives on the bacillus lactis, and at the expense of the lactic acid when in excess. In connection with this fact the excess of milk-sugar in infants' food becomes a very doubtful blessing. It may be known to some that these forty years I have constantly taught the advisability of avoiding that excess. Led by observations in the nursery and at the sick-bed, I have always taught that cane sugar (and not milk sugar) should be added to the food of infants, the milk-sugar of the cow's milk being sufficient to supply the required amount of lactic acid.

Chronic gastritis, besides the best known symptoms, causes mental and emotional disturbances amounting to hypochondria. Gastric fermentation produces hydrogen and carbonic acid which dilate the stomach and cause a diffused (not localized) pain. The irritated gastric nerves cause a disturbance of the nerve centres, with vertigo, severe headache and agoraphobia, and of the heart, with cardiac asthma, palpitation, and an arhythmic pulse.

The stomach is very apt to be overloaded. As long as the small intestine is crowded the stomach is, through reflex action, prevented from discharging its contents. Before the Moscow Congress Dr. Von Mehring detailed the following experiment: The duodenum of a dog was cut and both ends fastened in the abdominal wall. When the lower end was completely filled with milk or other absorbable material, water introduced into the stomach would not leave it through the fistula. Two important clinical observations become thereby amenable to an explanation: The first is this: that babies who are crowded with otherwise appropriate and absorbable food may die of marasmus; the second, that persistent constipation keeps the stomach filled with the ingesta, no matter of what nature, to the detriment of nutrition. The latter is, in these cases, impaired because of the nature of the stomach, which absorbs very little besides solutions of salt in water, peptones and solutions of dextrine or of grape sugar, and alcoholic beverages. Water, for instance, is not absorbed in the stomach. When it is introduced into the normal stomach, it is expelled through a duodenal fistula established for the purpose of observation.

Pepsin and rennet are secreted by the glandular cells of the pylorus and of the fundus; hydrochloric acid from the chlorides in

the circulation of the surface epithelia; lactic acid is produced by the bacteric fermentation of the carbohydrates contained in the stomach. When no milk-sugar or no other carbohydrates are introduced there is no lactic acid. After a meal consisting of hydrocarbons there is lactic acid, however, only for some time, say half an hour; after this period there is hydrochloric acid. At first it combines with the salts it meets, at the same time it interferes to a certain extent with the transformation of starch and stops its complete saccharification. Its principal effect, when in sufficient quantities, is the prevention of abnormal fermentation and putrefaction. These become prevalent when a gastric disease diminishes the secretion of hydrochloric acid.

In dilatation of the stomach, no matter whether the secretion of hydrochloric acid is wanting, diminished, normal, or excessive, mostly, however, when it is defective, the motory incompetence of the organ which results in undue retention of the contents, causes fermentation. It produces lactic, butyric and acetic acids, and gases. Carbonic acid and hydrogen originate in the putrefaction of hydrocarbons, hydrogen and sulphide of hydrogen in that of albuminoids. The accumulation of ingesta may cause endosmosis of water into the stomach. That process may lead to constipation, scanty urine, dry skin, and desiccation of the muscles and the nervous system. Tetany has been observed under such circumstances, partly from the changes in the physical structure of the nerve tissue, and partly from auto-infection.

Tuberculosis, typhoid, or other infectious ulcerations are rarely found in the stomach, because their bacilli meet hydrochloric acid during the few hours while chyme is forming. But a certain quantity of the acid in, and good motory power of, the stomach, beside a mere normal, not excessive, peristalsis are required to prevent putrefaction in the intestine. In the colon this putrefaction is quite common, and proves the introduction of microbes with the albuminoids. All sorts of infectious deposits, beside putrefaction, are noticeable when the microbes are introduced in great numbers; when the secretion of hydrochloric acid is insufficient; when the motory power of the stomach is impaired, and when the resistance on the part of the pylorus is incompetent. It is evident that these wants should be corrected. Abnormal acids in the stomach should be neutralized by alkalies; the motory power of the stomach increased by strychnine, electricity, massage, and hydrotherapeutic applications (mostly cold);

gastric catarrh relieved by occasional or regular irrigations; the insufficiency of pepsin by the administration of pepsin; the absence or lack of hydrochloric acid by its introduction in proper amounts of water, in a proportion of from 2 to 5 in 1000; and by a fair amount of sodium chloride to all kinds of food, mainly to cow's milk and to farinacea.

This demand is more than merely theoretical. In thousands of cases observed by me, of indigestion caused by the presence of fat acid (while hydrochloric acid was absent, or scanty, or retarded), I have seen immediate improvement by giving both, alkalies from five to ten minutes before meals for the purpose of neutralization, and hydrochloric acid (correctly diluted) during and immediately after meals. From 8 to 15 drops of the diluted acid in a glass of water, mostly hot, will usually suffice. When hydrochloric acid is secreted or introduced in sufficient or excessive quantity, pepsin may be absent. In those cases the latter should be given in addition.

To give pepsin alone, however, as a routine treatment, is rarely correct. For when it is absent, the epithelia are no better developed than the peptic glands. Thus, while pepsin is given it should be considered inert unless it meets hydrochloric acid in the stomach, or be combined with it. The wine of pepsin of the *National Formulary*, not yet admitted to the officinal *Pharmacopœia*, is composed on that principle.

Putrefaction which takes place in a stomach which is weakened by muscular incompetency during anæmia, convalescence, dilatation, or by congenital muscular insufficiency, should be treated locally; there is no reason why the slow process of improving secretion and motory power should be relied on solely. It is in these cases that resorcin is obviously a reliable remedy. An adult may take from one to one and a half grammes a day, a baby from four to ten centigrammes a day. If after a long search, as I have instituted it, you find a few reported instances of large doses which did not kill, there should be no temptation to give more than the small doses which I advise and which prove successful. The effect of resorcin is the more speedy and local the greater its solubility and the facility with which it may be combined with other drugs.

The choice of alkalies depends in part on indications other than that of mere neutralization. Bicarbonate of sodium will momentarily neutralize acids encountered in the stomach, but it incites the secretion of hydrochloric acid, an excess of which may prove

uncomfortable. It often causes a burning sensation. One of the principal objections to the bicarbonate may also lie in the evolution of carbonic acid. In the individual case it may be questioned whether its stimulating effect on peristalsis is preferable or objectionable when compared with the inflation of the stomach engendered by it. All carbonates have this disagreeable feature. That is why I prefer calcined magnesia, the "magnesia" of the *Pharmacopœia*. It has the additional advantage of relieving the constipation which is a frequent complication, and not infrequently a direct cause of a putrefying process in the stomach. An adult will take from two to four grammes a day, in from three or four to eight or ten refracted doses.

The irrigation of the stomach meets with difficulties in few instances only, with almost none in infants and children, in whom a catheter, No. 25 or 30 French, is sufficient. In the adult the postlaryngeal region may offer an occasional obstacle, which, however, is overcome by patience. When the pharynx is too irritable, or the patient refractory, the tube may be introduced through the larger, mostly the right, nostril. When it does not readily pass into the œsophagus the patient should be made to swallow, when it will glide down. Salt water solution of 7 : 1000 may be run through it from a funnel or a fountain syringe which is slightly raised above the level of the pharynx, and lowered when the fluid and stomach contents are to flow out. This salt water may be mixed with a disinfectant, say thymol, 1 : 3000 or 4000, or in cases of hyperacidity with bicarbonate of sodium 1 : 200 or 500. The temperature should be that of the body when this is normal, somewhat or considerably cooler when there is a high elevation, or warmer when there is a reduction of the body temperature. Alcohol should not be added to the injection, because its dilution is partly absorbed by the stomach. On the other hand, when water is injected without salt, it causes osmosis of the body fluids into the stomach, sometimes to such an extent as to visibly increase the amount returning from the stomach. The irrigations should amount to 100 and more cubic centimetres in the nursling, 200 or 300 in the child, 500 or 700 in the adult. They should be repeated until they return clear. The tube should always be withdrawn quickly so as to avoid irritation of the fauces.

Bile is credited with antiputrid properties, which, however, are not possessed by it in its alkaline or neutral condition, but are connected

with the free, mainly the taurocholic, acid. As bile (mainly, however, when exposed to air) undergoes putrefaction very readily, the main object during life is to keep the function of the liver normal. Unfortunately, whatever influence we may have over it can be attained only in the course of time. Neither salicylic acid, nor sulphate of sodium, nor calomel can be relied on in acute cases which require immediate correction or disinfection, except through their purgative effects.

When the acid contents of the stomach meet bile a deposit is formed which is dissolved in an excess of bile and in the sodium chloride which is formed during the neutralization of the hydrochloric acid. These changes are, however, not uniform, inasmuch as the acid gastric contents, the alkali and acid of the bile, and the alkali of the pancreatic juice, mix in different proportions.

In all probability the part taken by the pancreas in digestion and nutrition, when fully appreciated, will certainly be recognized more than formerly in our therapeutics. As a preventive the use of fats—cream, ice-creams, fried foods, and excessive albuminoids—should be avoided. Mercurials appear to stimulate the action of the pancreas. Such stimulation, however, is apt to become excessive, and the omission of mercurial over-medication (so common in former times) cannot but act favorably in the preservation of that organ. Still moderate mercurialization will always play an important rôle in its chronic inflammations of a sclerotic or of a syphilitic nature. So will the iodides. Carcinoma of the pancreas, either isolated or complicated, is in our times, unless it can be relieved by an operation, best treated by methylene-blue, the effects of which in retarding or even diminishing carcinomatous growths in all the viscera, I have too often noticed in these ten years to doubt their reality. Pilocarpine, whose action on the salivary glands appears established, may be tried in small doses. The stimulation of the duodenal glands by alkalies and bismuth may do good by exciting their vicarious action. The physiological incompetence of the pancreas may be rendered partly innocuous by the administration of animal pancreas or pancreatin. The former appears more physiological, for pancreatin is liable to be destroyed by the action of gastric acid.

In this way the absence of the function of this viscus, which certainly is a factor in causing intestinal toxicity, may be shorn of part of its deleterious effect. If not much of a curative agent in infection of the bowels, this method may become a preventive.

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There are, however, cases of pancreatic disease which show to a marvellous extent the self-help of nature. There are those in which indican is diminished for the following reason: One of the functions of the pancreas is the transformation of albuminoids into peptones, and of this into leucin and tyrosin. When fermenting they form skatol, phenol, and indol. The latter is developed in larger quantities out of pancreatin peptone than out of the albuminoids of meat; thus it appears that the peptic effect of the pancreatic juice (mostly trypsin) favors the production of indol. That is why *diseases* of the pancreas may diminish the amount of indol and its product, indican, to such an extent that even in obstruction of the small intestine, where an increase of indicanuria should be expected, the latter may be absent. (Leube.)

Another way in which nature appears to neutralize its own injuries is suggested in the facts that the result of peptones and their putrefaction, the formation of leucin and tyrosin, works its own destruction. Amongst their final productions is phenol, a disinfectant. That is not only so in the normal, but surely also in the diseased intestinal tract. It struck me decades ago, and I suggested the notion in a footnote in my *Treatise on Diphtheria* (page 93) nearly twenty years ago, that the rapid recovery and improvement of the general condition, for instance, after typhoid fever, might be due to the large amount of disinfecting phenol and other substances evolved out of the toxic material of intestinal secretions and excretions.

The processes of fermentation and putrefaction which take place in the intestine are least intense in the upper part of the gut, become more marked in the lower portion of the small intestine, and less so again in the lower colon after desiccation by fever has become more effective. In the duodenum and jejunum there is, under normal circumstances, no putrefaction, but fermentation only; albumin is not here decomposed by microbes; it is not, however, protected any longer by hydrochloric (which is no longer met with) but by organic acids. Whatever microbes are found in the normal small intestines decompose hydrocarbons through the formation of ethyl alcohol and organic acids.

The putrefaction of albuminoids which take place in the colon differs from pancreatic digestion. The latter furnishes albumoses and peptones, lysin, lysatenin, proteinochrome, amido acids, and ammonium. The putrefaction of albumin furnishes the same products, and proceeds further to the formation of indol, skatol,

parakresol, phenol, phenyl-propionic acid, fat acids, carbonic acids, hydrogen carbonoid, hydrogen sulphide, and some others, all of which have been studied by Nencki. Baumann, Brieger and Salkofski. Many of these products are of intense interest, because of their elimination through the kidneys; some, like the oxy-acids, are not changed at all; phenol is absorbed directly, indol and skatol have to be oxidized and are passed as indican and ether sulphuric acids. Their quantity, which depends upon the amount of intestinal putrefaction, determines the greater or smaller injuries suffered by the formerly healthy kidneys during the varied putrid and infectious processes or diseases. Indeed, the number of renal affections, from a slight and temporary irritation (with renal epithelium and hyaline casts and a few blood-cells) to a serious and incurable disease brought on by the absorption and forced elimination of toxins are very numerous. On the other hand, it requires no theoretical demonstration that kidneys previously diseased are not fit eliminators and add to the original dangers, and, finally, that in every case of intestinal intoxication, excessive putrefaction, or infection, the condition of the kidneys should be studied at once, and preserved in its form, or if possible, improved. Diuretics may often prove life-saving.

Not only food, but also the albuminous secretions of the intestines, and bile, undergo putrefaction by themselves; that is proved by the fact that putrefaction takes place during starvation, no food being present. It is only in the fœtus with its entire absence of intestinal putrefaction that biliary acids and coloring matter are met with undecomposed.

There are other facts which prove the occurrence of putrefaction in the intestine, even in the absence of food or food remnants.

The gut is capable of forming excrements without the presence of food or food remnants. When Hermann separated a circular piece of intestine from its contiguity it still became filled with a feculent mass. A thick conglomerate of epithelium is formed below a preternatural anus. The colon of a newly born contains frequently large masses of dry epithelia. Heidenhain found fecal masses consisting of epithelia and numerous nuclei originating in Lieberkühn's glands in experimental inanition and during the absence of bile. A frequent instance of this are the masses of epithelia narrowing the lumen of the colon which may be found in the intestines of many newly born.

Putrefaction inside of the gut does not reach the degree of that

outside the body for obvious reasons, which are mainly the presence of organic acids and the relative exclusion of atmospheric air. In the intestine the absence or diminution of absorption is also a powerful factor. That is, the more putrefaction the more fluid there is in the interior. Besides, the quantity of food is also of much importance. Carbon hydrates interfere with putrefaction; so does, but only to a certain extent, milk; more so, however, its fermented products—kefir, kumyss, and matzoon. Thus both theory and clinical experience favor the exclusion of meats and the selection of farinacea and milk preparations as the nutriment of patients suffering from intestinal putrefaction.

But Schmitz excludes casein from the praise due to milk; that is another proof of the correctness of many previous observations of the necessity of diminishing or of suspending it in the food of sick infants or of invalid adults.

Free acids interfere with putrefaction; therein lies part of the advantage of hydrocarbons which furnish acids through fermentation; thus these co-operate with the acids of the bile. It appears a pretty well established fact that putrefaction may be corrected by the presence of acids in the upper and the absence of water from the lower part of the tract. To the observation that absence of gastric hydrochloric acid led to increased putrefaction has been added the knowledge, both experimental and clinical, of its correction by the administration of hydrochloric acid. Another indication for the correctness of improper putrefaction and absorption of putrid material may also be found, perhaps, in diaphoresis, and in astringents, such as gallic acid and those vegetables which contain it. Many observations point to the adjuvant effect of opiates, because of their action in limiting secretion; still I hesitate to recommend them as a routine treatment. Indeed, no treatment should be routine.

In many a case it may be doubtful whether a microbic or toxic disease in a distant organ may be the result of intestinal putrefaction or not. Bacteria are but rarely found in the circulating blood or lymph; thus embolic deposits can but seldom take place in this way. In the moribund exceptions to this rule are met with, but in them the tissues and membranes resemble more or less those of the dead in regard to mechanical and chemical alterations. Fischl even claims that in the living the infiltration with leucocytes of the submucous tissue, and a secondary inflammatory process caused by the presence in the intestines of microbes, is rather a protection to the

organism against the migration of microbes from the alimentary tract. Still pneumonia, for instance, has often been claimed as the result of such emigration of streptococcus, staphylococcus, bacillus pyocyaneus, or bacterium coli; so have cystitis and pyelitis. But the methods of research have been charged in many such cases as having been incorrect and unsatisfactory. It is mainly the examinations of blood that, in the opinion of critics, left much to be desired. It is particularly the method of examining the blood taken from a finger which is considered inaccurate, because it is thought to be impossible to sterilize the surface and the ducts of the cutis with any amount of alcohol and ether, and it is claimed that the blood to be employed for a conclusive examination should be taken from a vein. Fischl claims that of many such cases of general sepsis induced by enteritis only those described by Escherich, by Hirsch, and by Libman are worthy of confidence. Thus, after all, there are certainly some instances of a general microbic infection originating in the alimentary canal that are not doubted at all. On the other hand, it is possible, as it was suggested forty years ago by Ritter von Rittershayn, that when a septic enteritis and a pneumonia or another infectious disease are found side by side, all of them may result from a common septic or septico-pyæmic source.

On the foundation of 194 papers and essays which he quotes and of his own research E. Opitz (*Zeitsch. f. Hyg. u. Infect.*, xxix. 1898) arrived at the following conclusions: That the intestinal wall when normal is not pervious for bacteria, and that no bacteria are absorbed into chyle during digestion, though there be slight lesions of the internal surface. Even serious chemical or mechanical lesions permit the admission of bacteria into the circulation in exceptional cases only. Nor is there a proof of the entrance into the circulation of bacteria from the intestine. As far as the kidneys are concerned, he came to the conclusion that they caused no physiological elimination of bacteria floating in the circulation. The presence in the urine of bacteria, previously injected into the circulation, is explained, according to him, only by mechanical and chemical lesions of the bloodvessel walls and of renal epithelia.

I have presented all these facts or suggestions which are taken to be the proofs against the alleged dangerousness of enteric putrefaction or infection in order not to be reproached with claiming too much myself. But after all, what does it all mean? Of the clinical facts proving the existence of auto-infection there can be no doubt

in the minds of practitioners and clinicians. If the microbes of these infections are not found in the circulation and in the distant organs, the cause must be something else. This something else is the toxin formed by the very bacilli.

Nor is this all. No amount of laboratory research of a negative character can nullify the merest clinical observation. In my own laboratory I examine the urines of 100 patients a week; no two weeks pass, I am certain, sometimes no week, in which an otherwise normal specimen of urine, perhaps in some cases discolored by a trace of albumin, does not contain bacteria, mostly of the coli order, enough to cause turbidity. This condition is not always complicated with serious septic troubles, sometimes with none at all. But still, there they are, and must come from somewhere. Spontaneous generation does not exist, and immigration is the only explanation. These are facts, and as it has often happened previously, when they were proclaimed to be impossible, the theory will be found to require modification, not the facts. Those bacteria come mostly from the intestines, rarely from outside through the urethra. Let me show you how that may, and probably does, occur.

Living tissues do not act like test-tubes or like dead membranes. The latter are pervious according to the simple laws of diffusion and osmosis; not so the former. Even the epithelial cell is an independent organism with an active contraction like an amœba, and with independence in regard to absorption. Fat molecules, for instance, enter the lymph ducts, but molecular pigment is rigorously excluded. In the intestinal epithelia of cold-blooded animals movements and changeable processes, like feelers, in and out, backward and forward, have been observed equal to those in amœbæ. Indeed, all differentiated cells choose what they mean to absorb; for instance, the epithelia of the mammary or other glands which select their proper food or constituent.

The practical conclusions are obvious. Disinfection must be resorted to. Disinfectants have sometimes been considered inopportune or contraindicated, because they cannot be given in sufficient doses to destroy bacteria or toxins. It is true that it is easier to destroy the living cells of the organism than bacteria. Not many years ago, however, Prudden could prove that a one-twentieth of a one per cent. solution of carbolic acid would annihilate the action of bacteria, not, indeed, by killing, but by paralyzing them. Charrin followed him lately. To prevent them from evolving toxins is as

beneficial as to destroy them. This is true of such internal remedies as clinical experience found to be indicated in those cases which are evolved out of, or are complicated with, the different forms of enteritis or entero-colitis. Vaughan believes that much harm and no good can be obtained from them—perhaps he speaks of injurious solutions only—but every clinician knows that the eminent bacteriologist is mistaken. It is true that calomel, naphthol, naphthalin, salol, and camphor in medicinal doses do not diminish the number of bacteria, nor even of saprophytes, but the microbes become less virulent. "By their fruits ye shall know them."

I advise practitioners not to be exclusively guided by statements coming from those who, while being expert and recognized bacteriologists, have less clinical experience. In the test-tube they obtain results which do not agree with other positive observations. They cannot, and sometimes do not, weigh the difference between a dead test-tube and the action of the living cell. I cannot but ever insist upon the fact that a number of well-observed and regulated clinical facts have the same dignity that is attributed to the results of microscopical and bacteriological exhibits. Both may be delusive or conclusive. When it is stated that disinfectants have not even an effect on putrefaction which is going on in the dilated stomach, though it be within reach and accessible, we know that this plea is erroneous. In the same way it has been claimed that intestinal putrefaction cannot be influenced. That is also a mistake. A number of years I have treated typhoid ulcerations and their offensive discharge with naphthalin. They were so readily disinfected, their fetor annihilated, and the character and number of the stools improved, that many seasons I made its administration a routine treatment. The same favorable result I often attained in the discharges of the tubercular intestine. In all such cases it is true, however, that the effect is modified by the quantity and quality of the contents, by the rapidity of expulsion, by the resisting power of the intestinal bacteria, and by the slowness or rapidity of absorption. It has been claimed that bacteria and their toxins are liable to be beyond reach because of the facility with which they enter the tissues of the intestinal mucous membranes. Now we are aware that we cannot reach, improve, or cure every case, but also that remedies may follow in the same tracks opened by the enemy. The result will depend on the quantity of bacteric or toxic material which can still be reached.

Remedies which are to act as disinfectants of the intestines must

be able to reach them. There are some that are known to pass the stomach undissolved, for instance, salol, salicin, naphthalin, and others. Many writers who are very doubtful in regard to other drugs admit that those mentioned may be of service. To permit soluble preparations to pass the stomach and to exhibit their effect in the bowels, they have been covered with keratin, which is not dissolved in the gastric acid or by other material of equal repute. I advise to try every such preparation for its merits, at least for its solubility. Many of them I have experimented with by exposing them to water, salt water, or acidulated water, and found them insoluble; before I did so I picked many of them out of the discharge of my patients. They withstood both stomach and bowels as if they had been so-called sugar-coated pills. And many will be the disappointments of practitioners who are so good-natured or confiding as to rely on claims not substantiated.

The soluble disinfectants whose action is said to be limited, or nearly so, to the stomach only, are more serviceable than they appear to be. Their solubility does not prove that they do not reach the intestine. This latter assertion was based on the belief in their absorbability while in the stomach. This organ, according to Meltzer and other physiologists, absorbs but little; the soluble disinfectant is carried down into the intestine with the rest of the gastric contents; moreover, the effect of tincture of iodine or the iodide in its combination with iron or of resorcin is well established. It is mainly the latter which is very reliable, though in the test tube its anti-fermentative action is no greater than that of chloral hydrate or nitrate of silver, and certainly inferior to menthol, thyme, beta-naphtol, or salicylic acid.

Next to a thorough expulsion by purgatives of the infected contents in its efficacy in intestinal putrefaction and in secondary infection of the organism (partly through the general blood and lymph circulation and partly through the kidneys), stands the improvement of the surface of the mucous membrane. Like chlorate of potassium, which by healing stomatitis prevents cocci or bacilli from entering the circulation in the mouth, so tannin, or better, gallic acid, which is tolerated in large doses—from three to six or eight grammes a day by adults—bismuth subnitrate or subgallate, tannigen, tannalbin, or nitrate of silver improve the condition of the mucous membrane and its epithelial cover so as to limit absorption.

During gastro-intestinal infection or intoxication the first indica-

tion is prevention by withholding or changing the food. Being taught by example and experience, I have not feared to deprive patients suffering from the vomiting and diarrhœa of gastro-intestinal infection of food for many hours or a day. Food introduced and brought up again and causing hyperistalsis and new infection is worse than food withheld. Of equal importance is a change in the selection of food. Acid (lactic acid) dyspepsia requires (egg) albumin-water, albuminoid putrefaction in the colon demands farinaceous food. Milk must be withheld in these acute cases. Give no sterilized or Pasteurized milk, no breast-milk. As I but lately said in an article on cholera infantum, in the *Twentieth Century Cyclopædia*, under ordinary circumstances milk feeds babies, under extraordinary circumstances bacteria. None should be given until the discharges are no longer offensive. Small babies or adults may take a mild tea in drachm doses, or a few drops of whiskey in barley-water may be given in short or longer intervals. A mixture which I used and recommended these thirty or forty years in the infectious diseases of the infant, when the period of vomiting and diarrhœa and starvation had passed by, consists of 150 c.cm. of barley-water, the white of one egg, one or two teaspoonfuls of whiskey, and some salt and cane-sugar. Milk-sugar should be carefully avoided in this condition. Of this mixture a teaspoonful is given every five or ten minutes.

Dyspeptic children are very apt to suffer from erythema as the result of intestinal infection or auto-infection, sometimes to such an extent that the diagnosis between it and scarlatina may become doubtful. The difficulty grows in those cases in which the intestinal erythema is attended by a corresponding intestinal fever, which is not at all an uncommon occurrence, and is frequently mistaken for malaria. Constipation, which does or does not accompany dyspepsia, may in rare cases lead to the same result. The diagnosis of the condition is not always easy, for such reasons as the apparently normal condition of the stomach, the absence of diarrhœa, and the actual or alleged absence of flatulency. This erythema is frequent; it may last hours or days, or alternate with acute attacks of urticaria. The latter is, therefore, not always gastric or neurotic, but may be toxic, and thus share the etiology of many cases of acne and senile pruritus. When in the face it may be mistaken for erysipelas.

This variety of erythema is sometimes seen on hands and feet, is symmetrical, and now and then, like urticaria, has vesicles of bullæ, sometimes in the shape of herpes iris. When it accompanies intes-

tinal infection, either imported or indigenous, it is usually accompanied by indican and the ether sulphuric acids in the urine, which is liable to be very scanty and of high specific gravity. Skatol and indol are found in the feces. In most cases a purgative will bring instant relief—calomel is the best; but a lasting improvement will only come from protracted disinfection of the intestinal tract by naphthalin, salol, resorcin, oil of peppermint, small doses of calomel or bichloride of mercury, from large enemata containing one-twentieth per cent. of thymol, one-fortieth per cent. of permanganate of potassium, or from such as consist of aromatic infusions (catnip, mint, chamomile); from occasional purgatives, and from the regulation of the diet which should be so arranged as not to cause fermentation and putrefaction. The sulphites of sodium and magnesium have disappointed me. Menthol should not be advised; it can be taken, however, by older children or adults, but in capsules only. It has a local irritant effect and has no properties not possessed by other drugs.

The practice of giving antifermentatives has preceded its theory for centuries. Still the theory is not quite so recent as some believe. In a paper on the "Treatment of Infant Diarrhœa and Dysentery," published in the *American Journal of Obstetrics, etc.*, 1876, I made the following remarks: "One indication is to destroy ferments. For that purpose most metallic preparations will do fair service. One of them is calomel; as to its effect as an antifermentative there can be no doubt. Possibly it acts by a portion of the drug being slowly changed into bichloride of mercury."

"Alcohol certainly arrests fermentation." "Sometimes, particularly when the stomach can be relied on, the salicylate of sodium may be added to the internal treatment. . . . The salicylic acid may prove beneficial, both by its antifebrile and disinfectant action." In my *Intestinal Diseases of Infancy and Childhood*, Detroit, 1887, I recommended calomel, bismuth, alcohol, creosote, salicylate of sodium, and resorcin.

Irrigation of the intestinal tract is performed while the patient is on his side, with raised hips. The nozzle of the irrigator (fountain syringe) or of the tube connected with a funnel is introduced a few centimetres beyond the internal sphincter, or much more. In the adult with a normal sigmoid flexure a tube may be introduced from 20 to 40 centimetres; but many reports of long distance introduction are to be accepted with caution, for a stiff tube is able to raise

the intestine and may be felt in the hepatic region, while a flexible one is liable to turn upon itself. That is particularly so in infants and small children in whom the sigmoid flexure is multiple and can rarely be passed by an instrument. In them, as in most adults, the raising of the hip may be successful. In some cases it is advisable to raise the lower half of the body according to the method I have followed these thirty years to reduce intussusception; in these cases I raise the body considerably and support the abdomen by a soft pillow while the face is turned to one side to facilitate respiration. While the anus is firmly closed the liquid is allowed to flow in from a slight elevation, from 10 to 50 centimetres. A greater elevation raises the pressure to an unbearable point. A slight elevation will improve the tolerance of the intestinal tract, which may thus be filled to the ileo-cæcal valve, and beyond. In rare cases the very stomach was reached. It is only an abnormal intestine, dilated in places, or bound down by previous adhesions, or normally sensitive, that resents the flow of the liquid by spastic contractions or pain or vomiting. The indication of a greater or smaller elevation is guided, in special cases, by the object or objects to be attained. Part of the liquid is absorbed, and quickly, too, sometimes. That is why, when that is not desirable, the irrigator should be raised. Then the intestine fills up more rapidly, and the return of the fluid, with the contents of the bowels, is more readily secured. From 1000 to 2000 or more cubic centimetres may thus be introduced into the bowels of an adult with the result of a thorough cleansing. Tepid or cool water should be chosen in those cases in which there is hyperthermy, water of the body temperature when the temperature is normal, hot water when there is hypothermy with or without actual collapse.

Medicinal agents may be added to the water. Beside salt to form a physiological solution, I recommended subnitrate of bismuth in dysentery. In typhoid fever and tuberculous and other ulcerations, thymol 1 : 3000 to 5000, permanganate of potassium in the same dilution; or bicarbonate of sodium, 1 : 100 to 500, have served a good purpose when the secretion of mucus was excessive; less, however, in membranous enteritis than in the usual form of catarrh. Such irrigations may be repeated a number of times daily, according to necessity.